APPENDIX 6.2
GEOPHYSICAL SURVEY

ALSF23

Alleston Solar Farm, Pembroke

GEOPHYSICAL SURVEY REPORT

PLANNING REF. n/a

Headland Archaeology Yorkshire & North
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Commissioned by Alleston Clean Energy Limited

27/02/2024

HEADLAND ARCHAEOLOGY

PROJECT INFORMATION:

PROJECT NAME	Alleston Solar Farm, Pembroke
TYPE OF WORK	Geophysical Survey
PLANNING REF.	n/a
PARISH NO.	n/a
CONSULTANT/AGENT	Statkraft UK Limited
CLIENT	Alleston Clean Energy Limited
PROJECT CODE	ALSF23
NGR	NGR 200402, 200083
PARISH	n/a
LOCAL AUTHORITY	Pembrokeshire County Council
FIELDWORK DATES	09/01/2024 – 18/01/2024
OASIS REF.	headland1-xxxxxxx
ARCHIVE REPOSITORY	Headland Archaeology

PROJECT TEAM:

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PROJECT SUMMARY

Headland Archaeology (UK) Ltd was commissioned by Alleston Clean Energy Limited (the Client) to undertake a geophysical (magnetometer) survey on land surrounding Alleston Farm located between Pembroke and Lamphey, Pembrokeshire, where the Client intends to submit a planning application for a solar farm. This geophysical survey report will be submitted as part of the planning application for the proposed development. The results may also inform future archaeological strategy, if required.

The survey has successfully evaluated the majority of the geophysical survey area (GSA) with the results highlighting the suitability of the geological conditions to magnetic prospecting methods, with the detection of a wide range and often complex arrangement of magnetic anomalies. Anomalies of archaeological, possible archaeological, agricultural, natural and modern origins have all been recorded and, in some instances, remain difficult to differentiate.

The survey has identified a circular enclosure west of Alleston Farm and two further partial enclosures immediately to the northwest and south of the farm. Also clearly recorded by the survey are several parallel ditch-like responses likely identifying former boundaries which pre-date boundaries recorded on tithe and early Ordnance Survey maps. The cause of other isolated but more coherent linear and curvilinear ditch-like responses, not aligned parallel to cultivation or natural trends remain of uncertain origin.

A complex palimpsest of linear and curvilinear responses are identified in the two southernmost fields of the GSA. An attempt to differentiate these responses has been made based on the anomalies individual magnetic signature, appearance and possible association with neighbouring anomalies, however a natural or possible archaeological cause is considered equally plausible for some of these features. An enigmatic parallel arrangement of discrete pit-like anomalies close to the northern boundary of the GSA remain of uncertain origin and no relationship is established with other neighbouring discrete anomalies.

Elsewhere, an area of magnetic disturbance and multiple adjacent, strongly enhanced, discrete anomalies are recorded in the location of Alleston quarry and a limekiln detailed on historic mapping also at the northern boundary of the GSA. A combination of geological and modern agricultural trends likely account for the banding of linear responses aligned west-northwest/east-southeast particularly evident across the southern half of the GSA.

The detection of a wide array of anomalies suggests the survey likely provides a reasonably good indication of the extent of sub-surface archaeological features within the GSA. No anomalies of note were recorded in the location of a delisted round barrow, also interpreted as a burnt mound located in the northwest corner of the GSA.

Overall, based solely on the results of the geophysical survey, the archaeological potential of the GSA is assessed as moderate to high in the immediate location of the identified enclosures but low elsewhere. The archaeological potential of the central parts of the two southernmost fields containing the densest concentration of magnetic responses remains uncertain.

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GEOPHYSICAL SURVEY REPORT

1. INTRODUCTION

Headland Archaeology (UK) Ltd was commissioned by Alleston Clean Energy Limited (the Client) to undertake a geophysical (magnetometer) survey on land surrounding Alleston Farm located between Pembroke and Lamphey, Pembrokeshire (Illus 1), where the Client intends to submit a planning application for a solar farm.

This geophysical survey report will be submitted as part of the planning application for the proposed development. The results may also inform future archaeological strategy, if required.

The scheme of work was undertaken in accordance with the requirements of Planning Policy Wales (Welsh Government 2024) and with the Written Scheme of Investigation for Geophysical Survey (WSI) (Headland Archaeology 2023).

The WSI was produced to the standards laid down in the European Archaeological Council's guideline publication, EAC Guidelines for the Use of Geophysics in Archaeology (Europae Archaeologia Consilium 2016) and the Chartered Institute for Archaeologists' (CIfA) Standard and Guidance for Archaeological Geophysical Survey (CIfA 2020). The survey was also carried out in line with the same best practice guidelines.

The survey was carried out between January 9th and January 18th 2024.

1.1. SITE LOCATION, TOPOGRAPHY AND LAND-USE

The geophysical survey area (GSA) is centred at NGR 200402, 200083 and surrounds Alleston Farm, approximately 0.6km to the west of Lamphey and approximately 1.7km to the east of Pembroke. The GSA covers approximately 88 hectares and comprises 15 fields under arable cultivation and pasture. Four of these fields to the east of the farm, are divided up into smaller paddocks. The GSA is bounded to the north by Lower Lamphey Road, Watery Lane to the west, agricultural fields to the east, and by a dense treeline to the south which extends from Alleston Wood. Alleston Wood also intersects the GSA to the south-west.

Topographically the land within the GSA is varied but generally slopes upwards from north to south from approximately 13m Above Ordnance Datum (AOD) in the northwest corner of the GSA to approximately 57m AOD at the southern extent of the GSA.

The majority of the fields within the GSA at the time of survey were fallow, containing the stalk remains of the previous maize crop (Illus 2 - Illus 4). Fields 9 and 11 and the parcel of land to the east of Alleston Farm were pasture (Illus 5).

Approximately 11.5ha of land immediately east and south-east of Alleston Farm was not available to survey due to the presence of horses which were unable to be moved.

1.2. GEOLOGY AND SOILS

The underlying bedrock geology is varied across the GSA comprising of bands of different sedimentary limestone and conglomerate and interbedded sandstone and argillaceous rocks crossing the GSA in an east-southeast/west-northwest direction. More specifically the different bedrock geologies are described below running from north to south;

- Pembroke Limestone Group - Limestone. Sedimentary bedrock formed between 358.9 and

329 million years ago during the Carboniferous period.

• Black Rock Subgroup and Gully Oolite Formation - Limestone. Sedimentary bedrock formed between 358.9 and 343 million years ago during the Carboniferous period).

• Avon Group - Limestone and mudstone, interbedded. Sedimentary bedrock formed between 358.9 and 346.7 million years ago during the Carboniferous period.

• Skrinkle Sandstone Formation - Sandstone. Sedimentary bedrock formed between 372.2 and 346.7 million years ago during the Devonian and Carboniferous periods.

• Ridgeway Conglomerate Formation - Conglomerate. Sedimentary bedrock formed between 410.8 and 372.2 million years ago during the Devonian period.

• Milford Haven Group - Argillaceous rocks and sandstone, interbedded. Sedimentary bedrock formed between 427.4 and 407.6 million years ago during the Silurian and Devonian periods.

A thin sinuous band of till, diamicton crossing the northern fields of the GSA to the south of and roughly parallel to Lower Lamphey Road, is the only overlying superficial deposit recorded across the GSA (BGS 2024).

The soils are classified as Soilscape 7 across the northern area of the GSA and Soilscape 6 to the south, described as freely draining and slightly acidic but base-rich soils and freely draining slightly acid loamy soils, respectively (Cranfield University 2023).

2. ARCHAEOLOGICAL BACKGROUND

The following is a summary of Dyfed Archaeological Trust Historic Environment Record (HER) data available on the Historic Wales (RCAHMW, 2021) map viewer.

Limited evidence of archaeological activity is recorded within the GSA and the immediate surrounding landscape. A single round barrow dating from the Bronze Age is recorded in two locations immediately within and outside the north-western corner of the GSA. This barrow (DAT3283, NPRN 300902) was previously listed as a scheduled monument but in 1990 was delisted and subsequently suggested may have been a burnt mound. It is no longer visible as an extant feature. The only other asset within or close to the GSA is the Grade II listed Alleston Farm. This farm is located at the centre of the GSA and is recorded as a listed, post-medieval house (DAT60593).

Analysis of historic tithe (The National Library of Wales Welsh Tithe Maps 2024) and Ordnance Survey (OS) mapping indicates there have been relatively few changes to the layout of fields contained within the GSA. A parallel tree lined boundary is recorded across the northwest corner of the GSA immediately south of the pylon base now in field F1 and F9 was previously separated in two by a boundary extending roughly northeast/southwest south of Alleston Farm. Also depicted on the OS Six Inch 1830s-1880s county layers map is Alleston Quarry and adjacent limekiln located on the northern boundary of the GSA within F6.

3. AIMS, METHODOLOGY & PRESENTATION

3.1. AIMS & OBJECTIVES

The principal aim of the geophysical survey was to gather information to establish the presence/absence, character, and extent of any archaeological remains within the GSA. This will enable an assessment to be made of the impact of the proposed development on any sub-surface archaeological remains if present, and thereby inform any further investigation strategies, as appropriate.

The specific archaeological objectives of the geophysical survey were:

- to provide information about the nature and possible interpretation of any magnetic anomalies identified,
- to therefore determine the likely presence/absence and extent of any buried archaeological features, and
- to prepare a report summarising the results of the survey.

3.2. METHODOLOGY

Magnetic survey methods rely on the ability of a variety of instruments to measure very small magnetic fields associated with buried archaeological remains. A feature such as a ditch, pit or kiln can act like a small magnet, or series of magnets, that produce distortions (anomalies) in the earth's magnetic field. In mapping these slight variations detailed plans of sites can be obtained, as buried features often produce reasonably characteristic anomaly shapes and strengths (Gaffney & Gater 2003). Further information on soil magnetism and the interpretation of magnetic anomalies is provided in Appendix 1.

Magnetometry is the most widely used geophysical survey technique in archaeology as it can quickly evaluate large areas and, under favourable conditions, identify a wide range of archaeological features including infilled cut features such as large pits, gullies and ditches, hearths, and areas of burning, and kilns and brick structures. It is therefore good at locating settlements of all periods, prehistoric field systems and enclosures, and areas of industrial or modern activity, amongst others. It is less successful in identifying smaller features such as post-holes and small pits (except when using a non-standard sampling interval), unenclosed (prehistoric) settlement sites and graves/burial grounds. However, magnetometry is by far the single most useful technique and was assessed as the best non-intrusive evaluation tool for this site.

The survey was undertaken using four Bartington Grad601 sensors mounted at 1m intervals (1m traverse interval) onto a rigid frame. The system was programmed to take readings at a frequency of 10Hz (allowing for a 10-15cm sample interval) on roaming traverses (swaths) 4m apart (Illus 6). These readings were stored on an external weatherproof laptop and later downloaded for processing and interpretation. The system was linked to a Trimble R12 Real Time Kinetic (RTK) differential Global Positioning System (dGPS) outputting in NMEA mode to ensure a high positional accuracy for each data point.

MLGrad601 and MultiGrad601 (Geomar Software Inc.) software was used to collect and export the data. Anomaly GeoSurvey v1.12.3 (Lichenstone Geoscience) and QGIS v.3.28.5 software was used to process and present the data respectively.

3.3. DATA PRESENTATION & TECHNICAL DETAIL

A general site location plan is shown in Illus 1 at a scale of 1:7,500. Illus 2 to Illus 5 inclusive are site condition photographs. Illus 6 shows the GPS swaths, and the location and direction of the site condition photographs, at 1:7,500. Illus 6 and Illus 7 show overviews of the processed magnetometer data and interpretation respectively, also at a scale of 1:7,500. Fully processed (greyscale) data, minimally processed data (XY trace plot) data and interpretative plans are presented by Sector, at 1:2,500, in Illus 9 to Illus 20 inclusive.

Technical information on the equipment used, data processing and magnetic survey methodology is given in Appendix 1. Appendix 2 details the survey location information and Appendix 3 describes the composition and location of the site archive. Data processing details are presented in Appendix 4. A copy of the OASIS entry (Online Access to the Index of Archaeological Investigations) is reproduced in Appendix 5.

The survey methodology, report and any recommendations comply with the Written Scheme of Investigation (Headland Archaeology 2023), guidelines outlined by Europae Archaeologia Consilium (EAC 2016) and by the Chartered Institute for Archaeologists (CIfA 2020). All illustrations from Ordnance Survey (OS) mapping are reproduced with the permission of the controller of His Majesty's Stationery Office (© Crown copyright).

The Illustrations in this report have been produced following analysis of the data in 'raw' (minimally processed) and processed formats and over a range of different display levels. All illustrations are presented to display and interpret the data to best effect. The interpretations are based on the experience and knowledge of Headland management and reporting staff.

4. RESULTS AND DISCUSSION

4.1. SITE CONDITIONS

Magnetometer survey is generally recommended over any sedimentary bedrock and responses are generally good over limestone geologies (English Heritage 2008; Table 4). The absence of any significant overlying drift deposits would also likely aid detection of magnetic anomalies. Magnetometry was therefore assessed the most appropriate non-

intrusive geophysical technique for evaluating the GSA, taking account of the limitations noted in Section 3.2 and above.

Surface conditions were generally average to good (Illus 2 to Illus 5 inclusive) and data quality was also good with only minimal post-processing required. No problems were encountered during the fieldwork, although no access was granted to the parcel under pasture east of Alleston Farm.

The survey results highlight the geological and pedological conditions across the GSA are receptive to magnetic prospecting methods with the detection of a wide and often complex range of magnetic anomalies against a moderately variable magnetic background. Anomalies of archaeological, possible archaeological, agricultural, natural and modern origins have all been identified and, in some instances, remain difficult to differentiate.

The results of the survey therefore likely provide a reasonably good indication of the extent of sub-surface archaeological features within the GSA.

The anomalies are discussed below according to their interpreted origin.

4.2. FERROUS AND MODERN ANOMALIES

Ferrous anomalies, characterised as individual 'spikes', are typically caused by ferrous (magnetic) material, either on the ground surface or in the plough-soil. Little importance is normally given to such anomalies, unless there is any supporting evidence for an archaeological interpretation, as modern ferrous debris is common on most sites, often being introduced into the topsoil during manuring or tipping/infilling.

Bands or small areas of magnetic disturbance recorded along the field edges are likely to be due to the accumulation of ferrous debris around field margins or to ferrous material in the boundary itself.

A large rectilinear area of magnetic disturbance (MD1; Illus 12-14) recorded at the northern boundary of F6 records the location of Alleston Quarry marked on the OS Six Inch 1830-1880 (county layers) map. The magnetic response is likely caused by the material used to infill the quarry.

Two high magnitude linear anomalies in F4 identify buried service pipes (SP1 and SP2; Illus 9-– 14).

Magnetic disturbance is also recorded around the large pylon bases in F1 and F2. The overhead cables linked to the pylon in F2 have also caused interference which has been recorded as a linear spread of magnetic disturbance extending across F1.

The cause of a row of ferrous spike and/or strongly enhanced anomalies approximately 100m north of Alleston Farm remains uncertain though is most likely of modern origin, possibly recording the location of a former track or fence line.

4.3. AGRICULTURAL ANOMALIES

The receptiveness of the geological conditions to magnetometer survey have led to the detection of a large number of linear trend anomalies identifying ploughing cultivation patterns across the GSA. Fields F10 and F12 south of Alleston Farm appear to contain two distinct alignments of regular parallel trend anomalies which are interpreted as a combination of both geological and agricultural trends. The identification of fewer linear anomalies in the pasture paddocks of F11 supports this hypothesis.

Those trends aligned with the longest axis of the field match modern cultivation patterns evident on Google Earth satellite imagery. The linear banding aligned west-northwest/east-southeast matches the mapped changes in bedrock geology across the GSA.

The only former boundaries identified by the survey which can be matched to historic mapping are recorded in fields F1 (FB1; Illus 11) and F9 (FB2; Illus 14).

Several other likely former boundaries have also been identified by the survey in fields F2 through F8 and F10 which possibly pre-date the tithe and OS Six Inch 1830-1880 (county layers) maps (FB?1 - FB?4; Illus 11, 14, 17 & 20). These linear and curvilinear responses have a distinct parallel double ditch-like response and it remains plausible that some of them could be archaeological in nature and associated with enclosures E1 – E3, though are considered more likely to represent former boundaries.

4.4. ANOMALIES OF GEOLOGICAL ORIGIN

As previously mentioned, the receptive nature of the sedimentary and limestone bedrock geology to magnetic survey methods has led to the detection of a range of anomalies, varying from isolated and clusters of amorphous, discrete enhanced anomalies, to more regular linear and curvilinear features all interpreted as of natural/geological in origin across the GSA.

Possible periglacial patterning and/or surface cracks in the bedrock geology may account for some the irregular, sinuous anomalies in F10, although a possible archaeological cause for some of these anomalies remains plausible especially given the presence of more regular ditch like features and enclosure E3 roughly 150m east-southeast.

The west-northwest/east-southeast alignment of the linear striations/banding across fields F10 and F12 corresponds to the changes in mapped bedrock geology across the GSA.

Other sinuous trend anomalies also likely natural in origin reflect the topographic variations across the site and general trend sloping up from north to south.

4.5. ANOMALIES OF UNCERTAIN ORIGIN

Several isolated discrete anomalies have been recorded across the GSA (ME1 - ME5; Illus 11 & 14) and have been interpreted as of uncertain origin on the basis that they cannot be confidently interpreted in any other category. These anomalies have a magnetic signature and/or level of enhancement indicative of an anthropogenic cause but remain of uncertain origin. Enhanced anomalies ME3, ME4 and ME5 are likely associated with adjacent former Alleston Quarry (detected as an area of magnetic disturbance MD1) and could identify areas of burning or possible limekilns as recorded on the OS Six Inch 1830-1880 (county layers) map.

A parallel row of weakly enhanced pit like anomalies stretching for approximately 75m at the northern boundary of F2 remain of uncertain origin. The anomalies are not of a strength that would indicate the remains of a modern fence line as evident in F5 and is therefore plausible they are archaeological in nature.

Linear anomalies (L1 – L5; Illus 11 , 17 & 20) which appear more regular or coherent in nature but that are isolated and/or located away from anomalies of archaeological or possible archaeological origin and which cannot be confidently interpreted as deriving from agricultural and/or natural causes are interpreted as of uncertain origin. The density of superimposed anomalies recorded in F12 restricts a more confident interpretation of the linear and curvilinear anomalies at L5 (illus 20) which are not aligned with the geological and/or agricultural trends and thus remain of uncertain origin.

Several broadly circular anomalies (RD?1 – RD?4 – Illus 11 & Illus 20) have been interpreted as possible ring ditches. These anomalies, broadly 7m to 10m in diameter are weakly enhanced and are distinct from other curvilinear anomalies because they are more coherent in nature. While an archaeological origin is considered possible, their weak magnetic signal and similarity to some other anomalies of natural origin precludes a more definitive interpretation.

4.6. ANOMALIES OF POSSIBLE OR PROBABLE ARCHAEOLOGICAL ORIGIN

One circular and two further partial enclosures have been recorded by the survey in fields F3, F5 and F11 respectively. The roughly circular enclosure (E1; Illus 9-11) at the southern boundary of F3 measures approximately 60m in diameter at its widest. It remains unclear whether a ditch like anomaly immediately to the north or possible former boundary FB?2 which cross the feature are associated with this enclosure.

A possible partial enclosure approximately 65m in diameter and associated ditches (E2 and D2; Illus 12-14) are identified at the southern boundary of F5 immediately northwest of Alleston Farm.

A further partial rectilinear enclosure (E3; illus 18-20) measuring approximately 55m in diameter is recorded at the southwest corner of F11. It remains unclear whether the enclosure is associated with other nearby ditch-like anomalies (FB?4 and D4) in neighbouring fields F10 and F12. As with enclosures E1 and E2 internal anomalies could suggest the presence of settlement activity. However, many of these are difficult to differentiate from the natural background.

More coherent ditch like anomalies not aligned with more regular agricultural and/or natural responses and which are located in close proximity to enclosures E1 – E3 are interpreted as possible archaeology (D1 – D4 inclusive; illus 8).

5. CONCLUSION

The survey has successfully evaluated all areas suitable for survey within the GSA and the results highlight the geological and pedological conditions across the site are receptive to magnetic prospecting methods with the detection of a wide and often complex range of magnetic anomalies against a moderately variable magnetic background.

Anomalies of previously unrecorded archaeological and possible archaeological origin have been mapped alongside numerous responses likely agricultural, natural and modern in origin. In some instances where these responses are most prevalent and are superimposed the exact cause remains difficult to differentiate.

The survey has identified a circular enclosure west of Alleston Farm and two further partial enclosures immediately to the northwest and south of the farm. Internal anomalies within these features could potentially represent settlement activity. In addition several broadly circular anomalies have been identified which could represent ring ditches of possible archaeological origin.

Also clearly recorded by the survey are several parallel ditch-like responses likely identifying former boundaries which pre-date boundaries recorded on tithe and early Ordnance Survey maps. The cause of other isolated but more coherent linear and curvilinear ditch-like responses, not aligned parallel to cultivation or natural trends remain of uncertain origin.

A complex palimpsest of linear and curvilinear responses is mapepd in the two southernmost fields of the GSA. An attempt to differentiate these responses has been made based on the anomalies individual magnetic signature, appearance and possible association with neighbouring anomalies, however a natural or possible archaeological cause is considered equally plausible for some of these features. An enigmatic parallel arrangement of discrete pit-like anomalies close to the northern boundary of the GSA remain of uncertain origin and no relationship is established with other neighbouring discrete anomalies.

Elsewhere, an area of magnetic disturbance and multiple adjacent, strongly enhanced, discrete anomalies are recorded in the location of Alleston quarry and a limekiln detailed on historic mapping also at the northern boundary of the GSA. A combination of geological and modern agricultural trends likely account for the banding of linear responses aligned west-northwest/east-southeast particularly evident across the southern half of the GSA.

The results of the survey therefore likely provide a good indication of the extent of sub-surface archaeological features within the GSA notwithstanding the limitations of the survey technique discussed herein and the complex superimposition of anomalous responses recorded in some areas of the GSA.

No anomalies of note were recorded in the location of the delisted round barrow monument (DAT3283), which has also been interpreted as a burnt mound located in the northwest corner of the GSA.

Overall, based solely on the results of the geophysical survey, the archaeological potential of the GSA is assessed as moderate to high in the immediate location of the identified enclosures but low elsewhere. The archaeological potential of the central parts of the two southernmost fields containing the densest concentration of magnetic responses remains uncertain.

6. REFERENCES

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7. APPENDICES

APPENDIX 1 MAGNETOMETER SURVEY

Magnetic susceptibility and soil magnetism

Iron makes up about 6% of the earth's crust and is mostly present in soils and rocks as minerals such as maghaemite and haematite. These minerals have a weak, measurable magnetic property termed magnetic susceptibility. Human activities can redistribute these minerals and change (enhance) others into more magnetic forms so that by measuring the magnetic susceptibility of the topsoil, areas where human occupation or settlement has occurred can be identified by virtue of the attendant increase (enhancement) in magnetic susceptibility. If the enhanced material subsequently comes to fill features, such as ditches or pits, localised isolated and linear magnetic anomalies can result whose presence can be detected by a magnetometer (fluxgate gradiometer).

In general, it is the contrast between the magnetic susceptibility of deposits filling cut features, such as ditches or pits, and the magnetic susceptibility of the topsoil, subsoil, and rock, into which these features have been cut, which causes the most recognisable responses. This is primarily because there is a tendency for magnetic ferrous compounds to become concentrated in the topsoil, thereby making it more magnetic than the subsoil or the bedrock. Linear features cut into the subsoil or geology, such as ditches, that have been silted up or have been backfilled with topsoil will therefore usually produce a positive magnetic response relative to the background soil levels. Discrete feature, such as pits, can also be detected.

The magnetic susceptibility of a soil can also be enhanced by the application of heat. This effect can lead to the detection of features such as hearths, kilns, or areas of burning.

Types of magnetic anomaly

In most instances anomalies are termed 'positive'. This means that they have a positive magnetic value relative to the magnetic background on any given site. However, some features can manifest themselves as 'negative' anomalies that, conversely, means that the response is negative relative to the mean magnetic background.

Where it is not possible to give a probable cause of an observed anomaly a '?' is appended.

It should be noted that anomalies interpreted as modern in origin might be caused by features that are present in the topsoil or upper layers of the subsoil. Removal of soil to an archaeological or natural layer can therefore remove the feature causing the anomaly.

The types of response mentioned above can be divided into five main categories that are used in the graphical interpretation of the magnetic data:

Isolated dipolar anomalies (iron spikes)

These responses are typically caused by ferrous material either on the surface or in the topsoil. They cause a rapid variation in the magnetic response giving a characteristic 'spiky' trace. Although ferrous archaeological artefacts could produce this type of response, unless there is supporting evidence for an archaeological interpretation, little emphasis is normally given to such anomalies, as modern ferrous objects are common on rural sites, often being introduced into the topsoil during manuring.

Areas of magnetic disturbance

These responses can have several causes often being associated with burnt material, such as slag waste or brick rubble or other strongly magnetised/fired material. Ferrous structures such as pylons, mesh or barbed wire and buried pipes can also cause the same disturbed response. A modern origin is usually assumed unless there is other supporting information.

Lightning-induced remnant magnetisation (LIRM)

LIRM anomalies are thought to be caused in the near surface soil horizons by the flow of an electrical

current associated with lightning strikes. These observed anomalies have a strong bipolar signal which decreases with distance from the spike point and often appear as linear or radial in shape.

Linear trend

This is usually a weak or broad linear anomaly of unknown cause or date. These anomalies are often caused by agricultural activity, either ploughing or land drains being a common cause.

Areas of magnetic enhancement/positive isolated anomalies

Areas of enhanced response are characterised by a general increase in the magnetic background over a localised area whilst discrete anomalies are manifest by an increased response (sometimes only visible on an XY trace plot) on two or three successive traverses. In neither instance is there the intense dipolar response characteristic exhibited by an area of magnetic disturbance or of an 'iron spike' anomaly (see above). These anomalies can be caused by infilled discrete archaeological features such as pits or post-holes or by kilns. They can also be caused by pedological variations or by natural infilled features on certain geologies. Ferrous material in the subsoil can also give a similar response. It can often therefore be very difficult to establish an anthropogenic origin without intrusive investigation or other supporting information.

Linear and curvilinear anomalies

Such anomalies have a variety of origins. They may be caused by agricultural practice (recent ploughing trends, earlier ridge and furrow regimes or land drains), natural geomorphological features such as palaeochannels or by infilled archaeological ditches.

APPENDIX 2 SURVEY LOCATION INFORMATION

An initial survey base station was established using a Trimble VRS differential Global Positioning System (dGPS). The magnetometer data was georeferenced using a Trimble RTK differential Global Positioning System (Trimble R10 model).

Temporary sight markers were laid out using a Trimble VRS differential Global Positioning System (Trimble R8s model) to guide the operator and ensure full coverage. The accuracy of this dGPS equipment is better than 0.01m.

The survey data were then super-imposed onto a base map provided by the client to produce the displayed block locations. However, it should be noted that Ordnance Survey positional accuracy for digital map data has an error of 0.5m for urban and floodplain areas, 1.0m for rural areas and 2.5m for mountain and moorland areas. This potential error must be considered if coordinates are measured off hard copies of the mapping rather than using the digital coordinates.

Headland Archaeology cannot accept responsibility for errors of fact or opinion resulting from data supplied by a third party.

APPENDIX 3 GEOPHYSICAL SURVEY ARCHIVE

The geophysical archive comprises an archive disk containing the raw data in XYZ format, a raster image of each greyscale plot with associate world file, and a PDF of the report.

The project will be archived in-house in accordance with recent good practice guidelines (http://guides.archaeologydataservice.ac.uk/g2gp/Geophysics_3). The data will be stored in an indexed archive and migrated to new formats when necessary.

APPENDIX 4 DATA PROCESSING

The gradiometer data has been presented in this report in processed greyscale and minimally processed XY trace plot format.

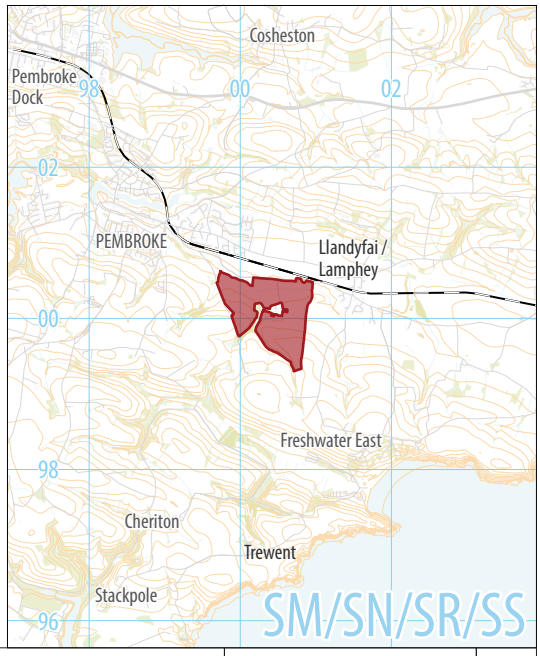
Data collected using RTK GPS-based methods cannot be produced without minimal processing of the data. The minimally processed data has been interpolated to project the data onto a regular grid and de-striped to correct for slight variations in instrument calibration drift and any other artificial data.

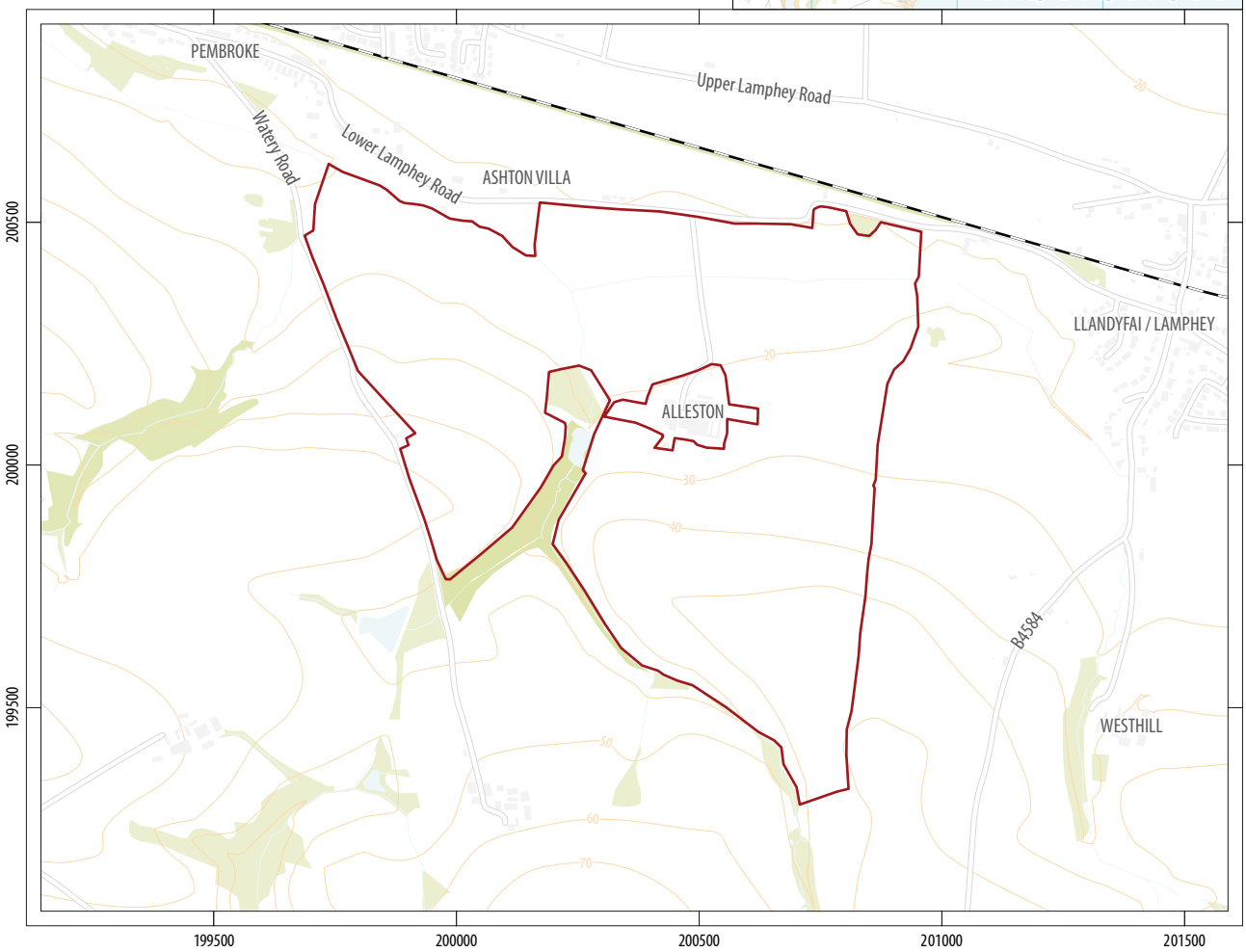
A high pass filter has been applied to the greyscale plots to remove low frequency anomalies (relating to survey tracks and modern agricultural features) to maximise the clarity and interpretability of the archaeological anomalies.

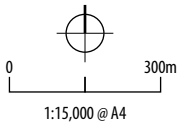
The data has also been clipped to remove extreme values and to improve data contrast.

APPENDIX 5 OASIS ARCHIVE

Alleston Solar Farm
Lower Lamphey Road
near Pembroke
Pembrokeshire







geophysical survey area

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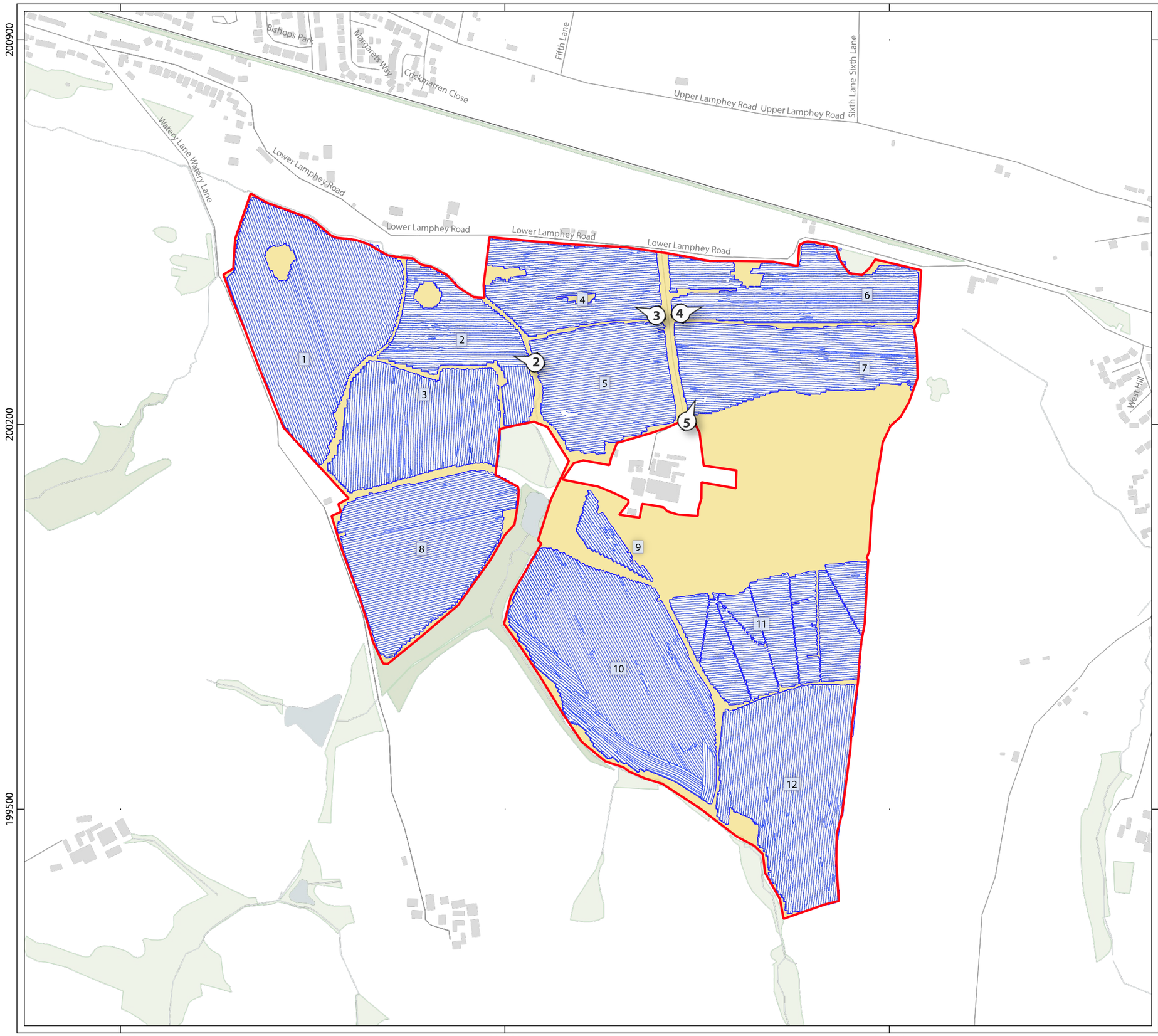
ILLUS 1 Site location

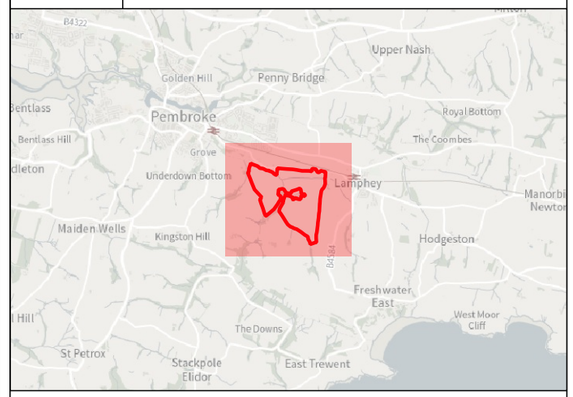
Illus 2 F2, looking west-northwest

Illus 3 F4, looking west-northwest

Illus 4 F3, looking east-northeast

Illus 5 F7, looking northeast





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Key

- Geophysical Survey Area
- Survey Extent
- Unsuitable Survey Area
- GPS Swaths
- Location and Direction for Illus 2 to 5

0 100 200 m

Site:	ALSF23
Created by:	CM
Checked by:	CA
Version:	v1.0
Date:	12/02/2024
Scale:	1:7,000 @ A3

Illus 06 - Survey location showing GPS swaths and photograph locations